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PATENT  
ATTORNEY DOCKET NO.: 041464-5018

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Assistant Commissioner for Patents  
**Box Patent Application**  
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of:

Inventor(s): Tomohiro KAWATA and Kunio MITOBE

For: SPEAKER UNIT

1. This new application is for a:  
☒ [ X ] Utility                      ☐ [ ] Design                      ☐ [ ] Plant
2. Papers enclosed which are required for a filing date:  
      9   Pages of specification including  
        Title Page  
      1   Page of claims and  
      1   Page of Abstract  
      5   Sheets of        ☒ [ X ] FORMAL        ☐ [ ] INFORMAL        drawings containing  
      6   Figures  
  
        ☐ [ ] The enclosed drawing(s) are photograph(s), and there is also attached a  
            PETITION TO ACCEPT PHOTOGRAPH(S) AS DRAWING(S)
3. Combined Declaration and Power of Attorney  
    ☒ [ X ] Enclosed - and is executed by all inventors  
    ☐ [ ] Not Enclosed  
        This application is being filed under the provisions of 37 C.F.R. §1.53(d).  
        Applicant(s) await notification from the Patent and Trademark Office of the time  
        set for filing the Declaration and paying the filing fees.
4. Language  
    ☒ [ X ] English  
    ☐ [ ] Non-English  
        This application is being filed in accordance with 37 C.F.R. §1.52(d) and §608.01  
        of the MPEP. Applicant(s) await notification from the Patent and Trademark

Office of the time set for filing the verified English translation and the processing fee.

## 5. Assignment

☐ is attached and Assignment of the invention is to \_\_\_\_\_  
☐ also enclosed is the Form PTO 1595, Recordation Form Cover Sheet.

☒ will be filed at a later date

## 6. Certified Copy

Application(s) from which priority is claimed are:

Country	Application No.	Filed
Korea	8-266684	September 17, 1996

Certified copy(ies) is/are ☒ attached ☐ will follow

## 7. Fee Calculation

CLAIMS AS FILED				
	Number Filed	Number Extra	at Rate of	Basic Fee Utility\$770.00 Design\$320.00
Total Claims (37 CFR 1.16(c))	3 - 20 =		\$ 22.00 each=	+
Independent Claims (37 CFR 1.16(b))	1 - 3 =		\$ 80.00 each=	+
Multiple dependent claim(s), if any (37 CFR 1.16(d))			\$260.00	+
SUB-TOTAL =				\$770.00
Reduction by 1/2 for filing by a small entity				- \$
TOTAL FILING FEE =				\$770.00

## 8. Small Entity Statement(s)

☐ Verified Statement(s) that this is a filing by a small entity under 37 C.F.R. §1.9 and §1.27 is(are) attached.

9. Fee Payment

☐ Not Enclosed.

**NO FEE IS BEING PAID BY CHECK OR DEPOSIT ACCOUNT AT THIS TIME.**

This application is being filed under the provisions of 37 C.F.R. §1.53(d).  
Applicant(s) await notification from the Patent and Trademark Office of the time set for filing the Declaration and paying the filing fees.

☒ Enclosed.

A check in the amount of \$ 770.00 representing the filing fee of \$ 770.00 is enclosed.

**Except** for issue fees payable under 37 C.F.R. §1.18, the Commissioner is hereby authorized by this paper to charge any additional fees during the entire pendency of this application including fees due under 37 CFR §1.16 and §1.17 which may be required, or credit any overpayment to Deposit Account 13-4520.

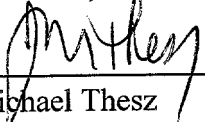
10. Additional papers enclosed.

- ☐ Preliminary Amendment
- ☐ Information Disclosure Statement
- ☐ Form PTO-1449
- ☐ Citations

**Please accord an application number and filing date.**

Respectfully submitted,

**MORGAN, LEWIS & BOCKIUS LLP**

  
\_\_\_\_\_  
J. Michael Thesz  
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Dated: September 16, 1997

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09931615.091697

## TITLE OF THE INVENTION

### Speaker Unit

## BACKGROUND OF THE INVENTION

5           The present invention relates to a speaker unit, in particular to a speaker unit which is thin in thickness and has an elliptical shape.

          There has been known a thin type speaker unit which is for use in a television set and whose vibrating diaphragm is usually formed into an elliptical shape. On the other hand, it is usually required that a magnetic circuit of a speaker unit be formed in a manner such that it can provide a uniform magnetic flux to the surface of a cylindrical voice coil. Accordingly, it is often required that a top plate and a permanent magnet each having a circular doughnut shape be used so that the whole magnetic circuit has a cylindrical shape.

          In fact, a thin type speaker unit usually has a magnetic circuit whose outer diameter is equal to or smaller than a width in a short axis direction of a frame structure which supports a vibrating diaphragm. In this way, a speaker unit as a whole may be made smaller, thus meeting with a requirement of making a compact speaker unit.

          However, in a thin type speaker unit as above related, since a magnetic circuit has to be made small in size due to a restriction caused by a width in the short axis direction of a vibrating diaphragm, the magnetic flux to be applied to the

surface of a voice coil will have a low density, resulting in a problem that the speaker unit has only a low sensitivity.

#### SUMMARY OF THE INVENTION

5        It is an object of the present invention to provide an improved speaker unit so as to solve the above-mentioned problem peculiar to the above-mentioned prior art.

10        According to the present invention, there is provided a speaker unit comprising: an elliptical vibrating diaphragm; a cylindrical voice coil secured at one end thereof on the center of the elliptical vibrating diaphragm; a frame structure for movably supporting the vibrating diaphragm, said frame structure being formed into a rectangular or elliptical shape and having a through hole in the center thereof; a  
15        magnetic circuit formed by (1) a top plate having a rectangular shape and having a through hole in the center thereof, (2) a plate-shaped magnet having a rectangular shape and having a through hole in the center thereof, (3) a back plate having a rectangular shape and having an upright pole on  
20        the center thereof. In this speaker unit, the top plate, the plate-shaped magnet and the back plate each has a width which is narrower than that of the frame structure in its shorter axis.

25        According to one aspect of the present invention, the frame structure, the top plate, the plate-shaped magnet and the back plate are arranged in parallel relation with one

another.

The above objects and features of the present invention will become more understood from the following description with reference to the accompanying drawings.

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#### BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is an exploded perspective view showing a series of elements for forming a magnetic circuit for use in a speaker unit according to the present invention.

10 Fig. 2 is an end view showing a speaker unit of the present invention in its shorter axis.

Fig. 3 is a side view showing a speaker unit of the present invention in its longer axis.

15 Fig. 4 is a perspective view showing a frame for use in the speaker unit of the present invention.

Fig. 5a is a front view showing a television set in which the speaker unit of the present invention is applied.

Fig. 5b is a top plane view showing the television set of Fig. 5a.

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#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Fig. 1, reference numeral 1 represents a rectangular top plate which is made of a magnetic material and has a center hole 1a. Reference numeral 2 represents a rectangular plate-shaped magnet having a center hole 2a.  
25 Reference numeral 3 represents a back plate 3 made of a

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magnetic material and having a center pole 3a smaller in diameter than hole 1a. Reference numeral 4 represents another plate-shaped magnet having a central hole 4a. The magnet 4 is used to cancel leaked magnetic flux from the magnet 2. Reference numeral 5 represents a case made of a magnetic material for receiving the top plate 1, the magnet 2, the back plate 3 and the magnet 4.

In use, the top plate 1 serves as a lid to cooperate with the case 5 so as to receive the magnet 2, the back plate 3 and the magnet 4. In this way, magnetic flux possibly leaked from the magnet 2 will be effectively blocked so as to be confined within the case 5.

Referring to Figs. 2 - 4, reference numeral 6 represents a rectangular parallelepiped frame structure which is used to movably support an elliptical vibrating diaphragm (not shown). As shown in Fig. 4, the frame structure 6 is formed with an elliptical recess portion 6a for receiving an elliptical vibrating diaphragm. Further, a center hole 6b, which has the same diameter as that of the center hole 1a of the top plate 1, is formed on the bottom of the elliptical recess portion 6a.

Referring again to Figs. 1 and 3, the frame structure 6, the top plate 1, the magnet 2, the back plate 3 and the magnet 4 are assembled together with their longer axes arranged in parallel with one another.

Referring to Fig. 3, the frame structure 6 is the longest

in length.

After being assembled into a condition as shown in Fig. 3, the hole 1a of the top plate 1, the hole 2a of the magnet 2, the hole 4a of the magnet 4 and the hole 6a of the frame structure 6 are all aligned in a vertical line so that the centers of these holes become coincident with one another, thereby permitting the center pole 3a of the back plate 3 to be inserted through all these holes. In this way, a magnetic circuit is formed by virtue of the top plate 1, the magnet 2 and the back plate 3. A magnetic gap is formed in an annular space formed between the inner wall of the hole 1a and the surface of the center pole 3a. A cylindrical voice coil (not shown) having one end thereof fixed at the center of a vibrating diaphragm (not shown) is inserted in the annular space.

Referring to Fig. 2, the frame structure 6 has a larger width than the top plate 1, the magnet 2 and the back plate 3. As compared with a conventional speaker unit where a doughnut-shaped magnet is used to form a cylindrical magnetic circuit, since the magnet 2 in the present invention has a larger volume than that in prior art, the magnetic flux to be applied to the voice coil will have a larger density. Further, since the magnetic circuit in the present invention is shorter in its longer axis and narrower in its shorter axis than the frame structure 6, a cabinet (into which the speaker unit is to be received) is required to have only a small



volume which may be the same as that of a cabinet for a conventional speaker unit (having a cylindrical magnetic circuit), but achieving a higher sensitivity than a conventional speaker unit.

5           Fig. 5a is a front view and Fig. 5b is a top plane view, showing an example where the speaker unit of the present invention is installed in a television set. As shown in Fig. 5a, the television set comprises a frame 10 holding a display 30. Provided on either side of the display 30 is a speaker unit 20 manufactured in accordance with the present invention. It has been found that the speaker unit of the present invention is particularly suitable for use in a television set in which there is only an elongate narrow space for installing a speaker unit.

10           It is understood from the above description that with the use of the present invention, the magnet of a speaker unit is allowed to be made larger than prior art so that the magnetic flux to be applied to the voice coil will have a higher density than prior art, thereby enabling a speaker unit to obtain an improved sensitivity.

15           Further, since the magnetic circuit in the present invention is shorter in its longer axis and narrower in its shorter axis than a frame structure for supporting a vibrating diaphragm, a cabinet (into which the speaker unit is to be received) is required to have only a small volume which may be the same as that of a cabinet for a conventional speaker unit

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(having a cylindrical magnetic circuit), but achieving a higher sensitivity than a conventional speaker unit.

While the presently preferred embodiments of the this invention have been shown and described above, it is to be understood that these disclosures are for the purpose of illustration and that various changes and modifications may be made without departing from the scope of the invention as set forth in the appended claims.

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WHAT IS CLAIMED IS:

1. A speaker unit comprising:

an elliptical vibrating diaphragm;

a cylindrical voice coil secured at one end thereof on the center of the elliptical vibrating diaphragm;

a frame structure for movably supporting the vibrating diaphragm, said frame structure being formed into a rectangular or elliptical shape and having a through hole in the center thereof;

a magnetic circuit formed by (1) a top plate having a rectangular shape and having a through hole in the center thereof, (2) a plate-shaped magnet having a rectangular shape and having a through hole in the center thereof, (3) a back plate having a rectangular shape and having an upright pole on the center thereof;

wherein the top plate, the plate-shaped magnet and the back plate each has a width which is narrower than that of the frame structure in its shorter axis.

2. The speaker unit according to claim 1, wherein the frame structure, the top plate, the plate-shaped magnet and the back plate are arranged in parallel relation with one another.

3. The speaker unit according to claim 1 is installed on either side of a television display on a television set.

## Speaker Unit

### Abstract of the Disclosure

There is provided a speaker unit comprising: an elliptical vibrating diaphragm; a cylindrical voice coil secured at one end thereof on the center of the elliptical vibrating diaphragm; a frame structure for movably supporting the vibrating diaphragm, said frame structure being formed into a rectangular or elliptical shape and having a through hole in the center thereof; a magnetic circuit formed by (1) a top plate having a rectangular shape and having a through hole in the center thereof, (2) a plate-shaped magnet having a rectangular shape and having a through hole in the center thereof, (3) a back plate having a rectangular shape and having an upright pole on the center thereof. In this speaker unit, the top plate, the plate-shaped magnet and the back plate each has a width which is narrower than that of the frame structure in its shorter axis.

# COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

U.S. DEPARTMENT OF COMMERCE  
Patent and Trademark Office

ATTORNEY DOCKET NO.:

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

"  
SPEAKER UNIT"

the specification of which:

is attached hereto; or

was filed as United States application Serial No. \_\_\_\_\_ on \_\_\_\_\_ and was amended on \_\_\_\_\_ (if applicable); or

was filed as PCT international application Number \_\_\_\_\_ on \_\_\_\_\_ and was amended under PCT Article 19 on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the U.S. Patent and Trademark Office information which is material to the patentability of claims presented in this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

## PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. §119:

COUNTRY (if PCT, indicate PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. §119	
Japan	8-266684	17/9/1996	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
			<input type="checkbox"/> Yes	<input type="checkbox"/> No
			<input type="checkbox"/> Yes	<input type="checkbox"/> No
			<input type="checkbox"/> Yes	<input type="checkbox"/> No

Combined Declaration For Patent Application and Power of Attorney - (Continued)  
(includes Reference to PCT International Applications)

ATTORNEY DOCKET NO.:

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to the patentability of claims presented in this application in accordance with Title 37, Code of Federal Regulations, §1.56(a) which became available between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. §120:

U.S. APPLICATIONS		STATUS (Check One)		
U.S. APPLICATION NO.	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.			STATUS (Check One)		
PCT APPLN. NO.	PCT FILING DATE	U.S. SERIAL NO.	PATENTED	PENDING	ABANDONED

**POWER OF ATTORNEY:** as a named inventor, I hereby appoint the following attorneys to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

**MORGAN, LEWIS & BOCKIUS**

Robert J. Gaybrick, Reg. No. 27,890; John G. Smith, Reg. No. 33,818; Song K. Jung, Reg. No. 35,210;  
Michele Schafer, Reg. No. 34,717; Matthew T. Bailey, Reg. No. 33,829; Bruce G. Bernstein, Reg. No. 34,550;

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Direct Telephone Calls To:  
(name and telephone number)

**Robert J. Gaybrick**  
(202) 467-7501

Combined Declaration For Patent Application and Power of Attorney - (Continued)  
(includes Reference to PCT International Applications)

ATTORNEY DOCKET NO.:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

FULL NAME OF SOLE OR FIRST INVENTOR	Tomohiro KAWATA		
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POST OFFICE ADDRESS	c/o Tohoku Pioneer Electronic Corporation 1105 Aza Nikko, Ooaza Kunomoto, Tendo-shi, Yamagata-ken 994 Japan		
FIRST OR SOLE INVENTOR'S SIGNATURE	<i>Tomohiro Kawata</i>		DATE July 9, 1997
FULL NAME OF SECOND INVENTOR	Kunio MITOBE		
RESIDENCE & CITIZENSHIP	CITY AND STATE OR CITY AND FOREIGN COUNTRY Yamagata-ken, Japan	COUNTRY OF CITIZENSHIP Japan	
POST OFFICE ADDRESS	c/o Tohoku Pioneer Electronic Corporation 1105 Aza Nikko, Ooaza Kunomoto, Tendo-shi, Yamagata-ken 994 Japan		
SECOND INVENTOR'S SIGNATURE	<i>Kunio Mitobe</i>		DATE July 9, 1997
FULL NAME OF THIRD INVENTOR			
RESIDENCE & CITIZENSHIP	CITY AND STATE OR CITY AND FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP	
POST OFFICE ADDRESS			
THIRD INVENTOR'S SIGNATURE			DATE Jul 9, 1997

Listing of Inventors Continued on attached page(s)

[ ] Yes

[ ] No

FIG.1

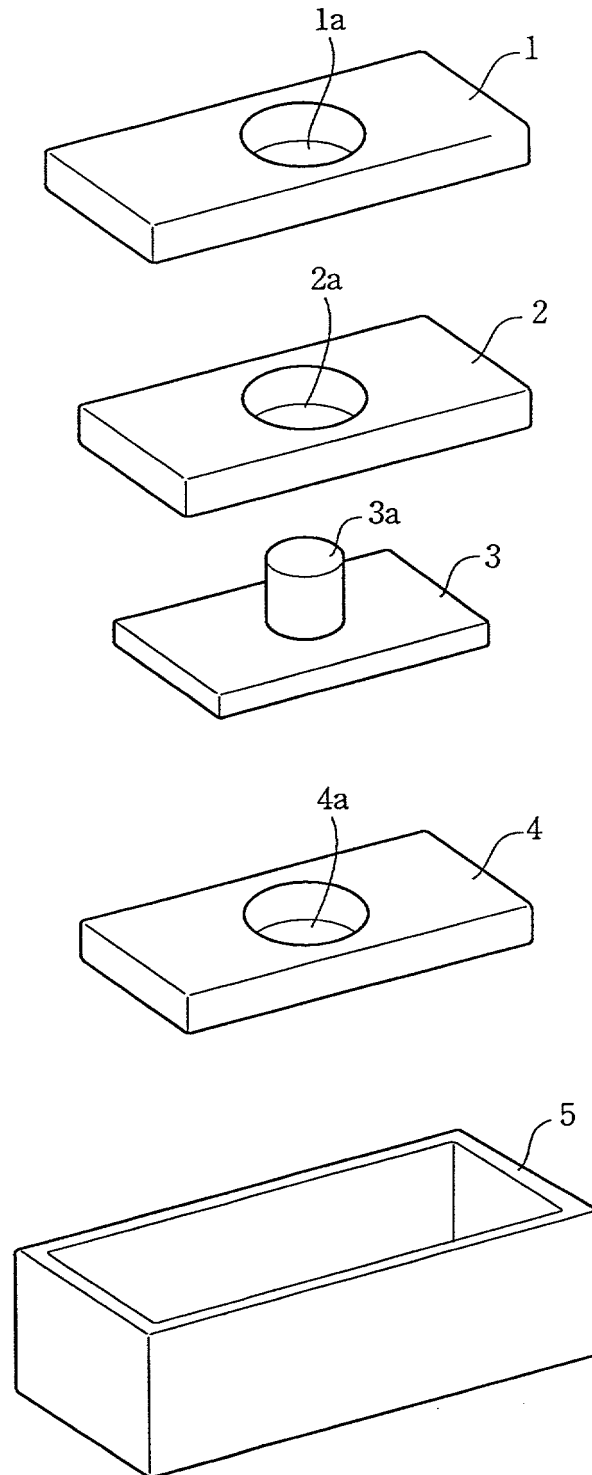




FIG.2

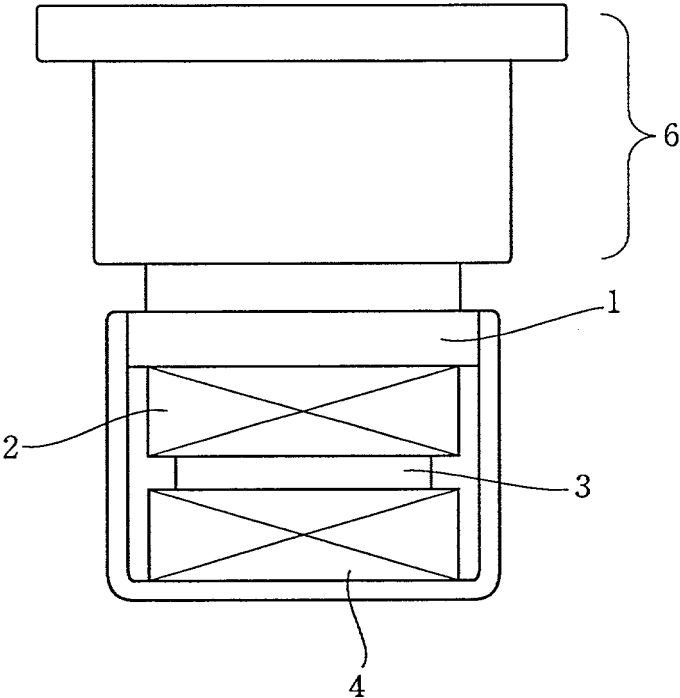


FIG.3

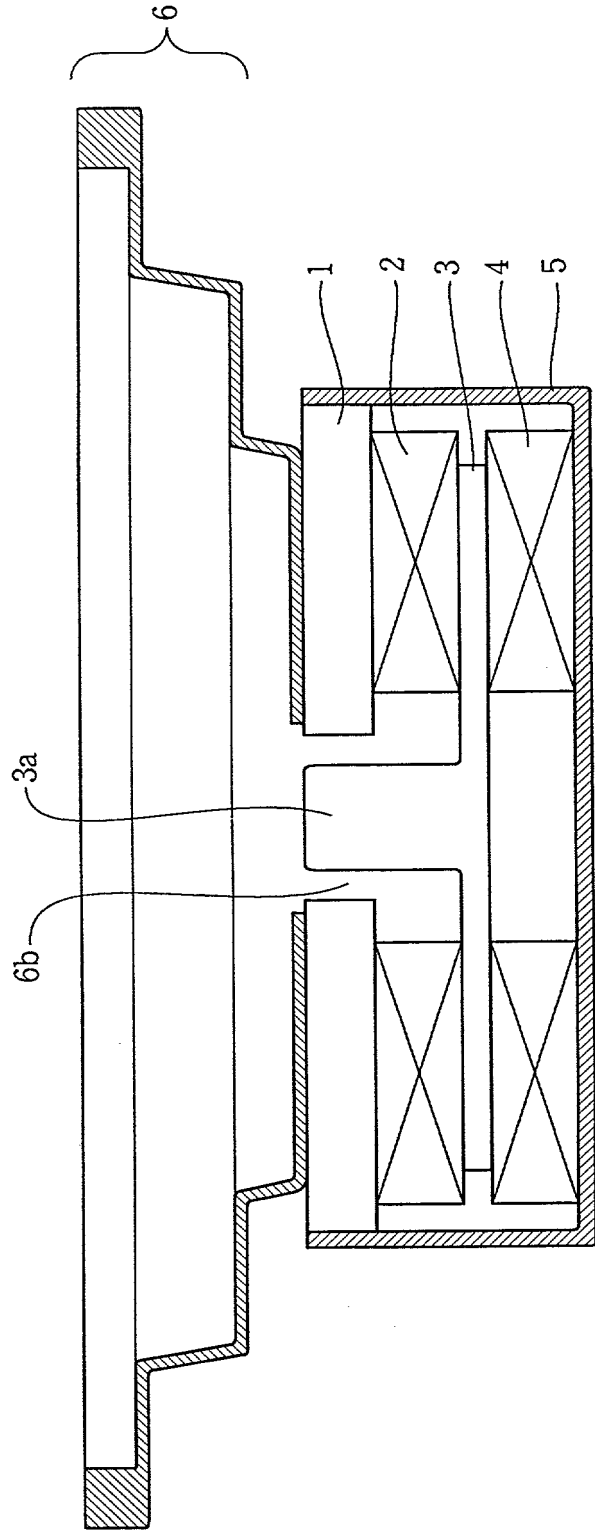


FIG.4

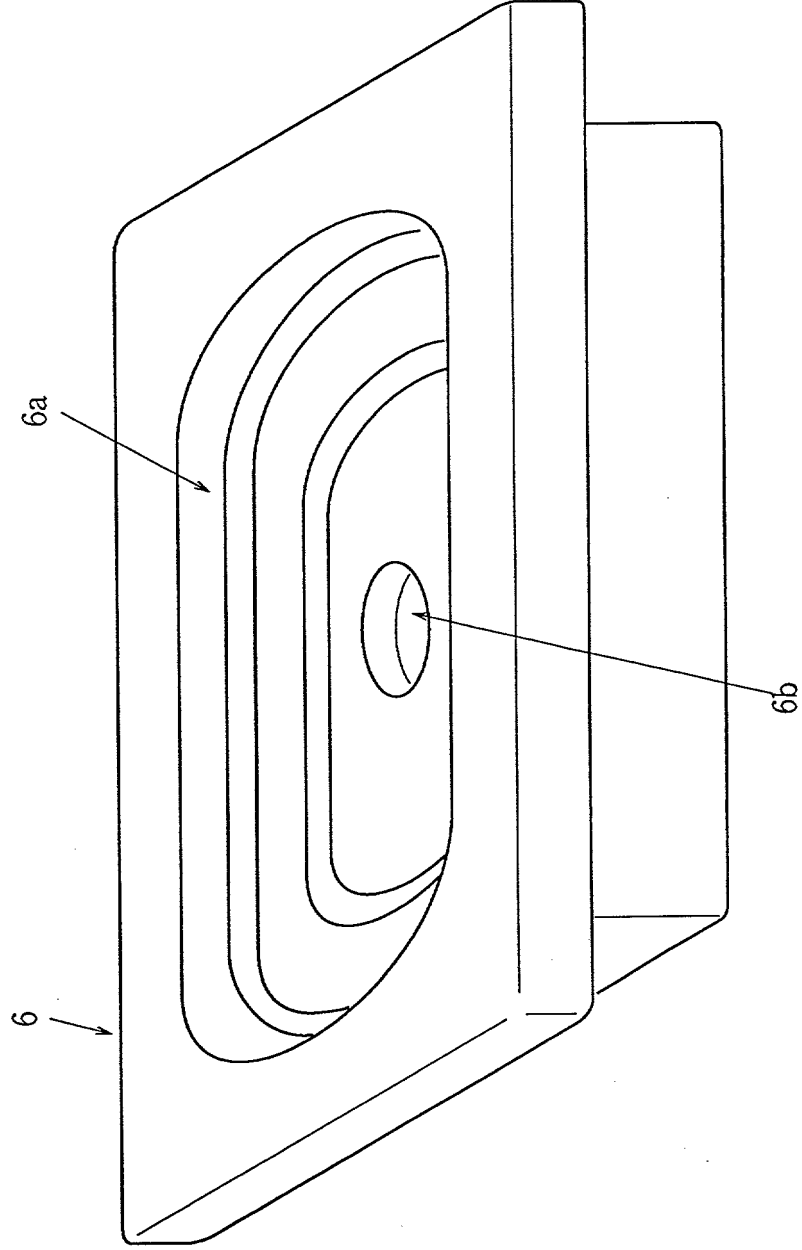


FIG.5 a

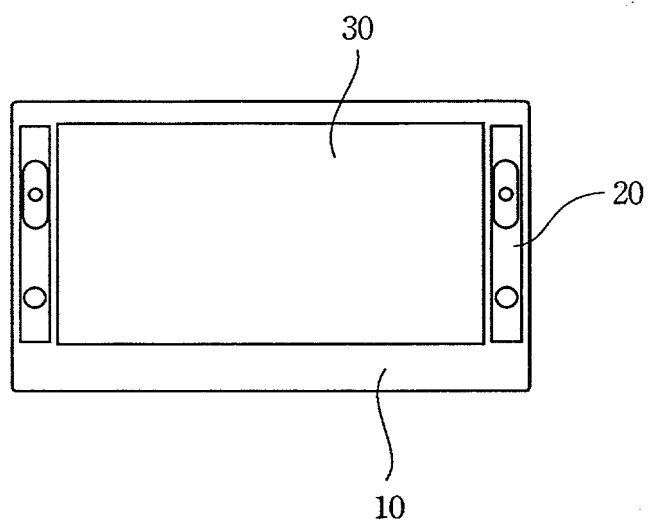


FIG.5 b

